REMARKS

Summary of Amendments

Claim 2 has been amended to focus its recited subject matter on the aspect of the present invention recited in claim 4. Claim 4 has therefore been canceled. While the amendments to claim 2 thus incorporate the limitations of claim 4, the amendments go further, distinguishing Applicant's inventive method as specifically described on pages 10 and 11 of the specification.

Applicant's earlier replies of February 18 and June 27, 2008 have already quoted the relevant passages from the specification detailing this specific aspect of the present invention. The amendments to claim 2 are thus fully supported by the present specification.

Incidentally, Applicant's June 27, 2008 reply, by incorporating the limitations of claim 7 into claim 2, and likewise incorporating the limitations of claim 8 into claim 3, rendered claim 3 redundant over claim 2. Consequently, claim 3 has been canceled.

Claim 6, formerly an independent claim, has been amended to depend from claim 2. Claims 1 and 7-9 were previously canceled.

In sum, then, independent method **claim 2** and dependent product **claim 6** are the sole claims pending.

(The "Office Action Summary" sheet attached to the front of the Office's September 29, 2008 communication mistakenly indicates that claims "1-9" are pending, and that claims "1-4 and 6" are rejected. Nevertheless, claims 2-4 and 6 as the only pending claims were the claims examined in the September 29 action.)

Claim Rejections – 35 U.S.C. § 103

Claims 2-4 and 6: *Zaitsev* (in view of routine skill in art)

Claims 2-4 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Optical Properties of Diamond: A Data Handbook* by A. M. Zaitsev, in view of alleged routine skill in the art.

The current rejections, made final, are essentially a verbatim repetition of the rejections made in the previous Office action of March 28, 2008, except that the text of the rejections of claims 7 and 8 from the March 28 action has been inserted *mutatis mutandis* into the text of the claim 2 and 3 rejections.

The only other difference between the text of the present rejections and that of the March 28 rejections is the allegation that *Zaitsev* teaches the lower sheet resistance, 1.4×10^4 $\Omega/\square$. To support its allegation, the Office notes—as Applicant has also noted—that under the caption to Fig. 5.107, *Zaitsev* states, "The **annealing** behavior of the H3 center strongly depends on the type of diamond and irradiation conditions."

Nevertheless, it is respectfully asserted that that observation in *Zaitsev* is merely a call to experimentation; by no means is this quoted observation a disclosure, a teaching, or even a suggestion as to what sort of irradiation conditions in what type of diamond would lead to a particular annealing behavior.

Claim 2 now sets forth

> A method of manufacturing *n*-type semiconductor diamond, the method employing an ion-implantation apparatus having an electron-beam line and *Li* and *N* ion-beam lines, and the method comprising:
> a preparatory step of providing single-crystal Type IIa or undoped epitaxial diamond essentially not containing impurities;
> an implantation step of irradiating the diamond with the *Li* and *N* ion-beam lines simultaneously and in such a manner as to implant into the diamond *Li* ions at a dose of at least 3.0×10^{15} cm^{-2} and *N* ions at a dose such that the *Li* and *N* sum-total dose is at least 7.0×10^{15} cm^{-2}, and so that ion-implantation depths at which the post-implantation *Li* and *N* concentrations each are at least 1600 ppm will overlap;
> an irradiation step, concurrent with said implantation step, of irradiating the diamond with the electron beam to cause the implantation Li and N ions to distribute in locations within the diamond in which *Li–N* pairing is likely to occur; and
> a step of annealing said diamond incorporating *Li* and *N* at a temperature in the range of from 800°C to less than 1800°C, under high-pressure conditions of at least 3 GPa so as to cause *Li* and *N* pairing to occur to the exclusion of *Li* associating with implantation-caused vacancies in the diamond, such that the *Li–N* pairs do not associate with vacancies but instead become electrically activated shallow donors;
> whereby said diamond has a sheet resistance of not greater than 1.4×10^4 $\Omega/\square$.

(Emphasis added.)

Under "Response to Applicant's Arguments" in its September 29, 2008 action, the Office—even properly considering the present claims as to a method (claims 2 and 3) and not just a product (claim 6)— takes the position that the claims as then examined merely recite ranges that, absent a showing of criticality, "can be considered as optimum workable ranges."

Notwithstanding whether the Office's allegation is technically proper, Applicant has amended claim 2 to recite specifics of a method according to Applicant's invention that, taken together, in no way can be said to involve merely "optimum workable ranges." As is clear from claim 2 as quoted on the previous page, the present invention as therein recited is—despite the Office's implication to the contrary—a far cry from an optimization of diamond annealing so as to achieve a particular sheet resistance.

The second paragraph of Response to Applicant's Arguments refers to page 7, lines 6-12 of Applicant's June 27, 2008 reply, paraphrasing Applicant's argument that *Zaitsev* nowhere teaches or even suggests the inventors' discoveries as described on pages 10 and 11 of the present specification. That is, (again, as argued in Applicant's February 18, 2008 reply),

> the methods of the present invention bring about *Li* and *N* pairing, such that the *Li–N* pairs do not associate with vacancies but instead become electrically activated shallow donors. This unexpected pairing of *Li* and *N* dopant ions leads to the low sheet resistance that is a distinguishing feature of *n*-type diamond according the present invention.

The Office concludes the second paragraph of under Response to Applicant's Arguments by stating, "The limitation is not [re]cited in the claim."

Now, however, claim 2 recites an *n*-type diamond manufacturing method employing an ion-implantation apparatus having an electron-beam line and *Li* and *N* ion-beam lines, the method comprising:

- an implantation step of irradiating an essentially impurity-free, single-crystal Type IIa or undoped epitaxial diamond with the *Li* and *N* ion-beam lines simultaneously and in such a manner as to implant into the diamond *Li* and *N* at predetermined doses and so that the implantation depths where their concentrations each are at least 1600 ppm will overlap;

- an irradiation step, concurrent with the implantation step, of irradiating the diamond with the electron beam to cause the implantation *Li* and *N* ions to distribute in locations within the diamond in which *Li–N* pairing is likely to occur; and

- a step of annealing the diamond under temperature and pressure conditions so as to cause *Li* and *N* pairing to occur to the exclusion of *Li* associating with implantation-caused vacancies in the diamond, such that the *Li–N* pairs do not associate with vacancies but instead become electrically activated shallow donors.

It is respectfully submitted that *Zaitsev* nowhere teaches or even suggests steps in an *n*-type diamond manufacturing method such as would lead to pairing of *Li* and *N* dopant ions in the manner of he present invention as now expressly recited in claim 2, summarized immediately above. And as is clear from the present specification, it

is this phenomenon, achieved by a method of the present invention as clearly set forth in claim 2, that leads to the low sheet resistance, also recited in claim 2, that is a distinguishing feature of *n*-type diamond according the present invention.

It is believed that claim 2 should thus be held allowable. And because claims 3 and 4 have been canceled and claim 6 amended to depend from claim 2, it is respectfully submitted that the entirety of the rejections in the September 29, 2008 action have been fully addressed.

Conclusion

Accordingly, it is believed that the rejections have been overcome and that the issues impeding allowance of this application have been resolved. Nonetheless, if despite Applicants thus having made their best attempt to advance the prosecution of this case the Office finds that there are issues still standing in the way of allowance—and given that Applicant has now made a second RCE—the Examiner is courteously urged to contact Applicant's undersigned representative at an early date, for the sake of resolving any such issues so as to avert further rejection of the pending claims.

Respectfully submitted,

November 29, 2008   /James Judge/

James W. Judge
Registration No. 42,701

JUDGE PATENT ASSOCIATES
Dojima Building, 5th Floor
6-8 Nishitemma 2-Chome, Kita-ku
Osaka-shi 530-0047
JAPAN

Telephone: **305-938-7119**
Voicemail/Fax: **703-997-4565**